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LARGE PILE

CONCRETE TRETTLES

PHILADELPHIA

PORTLAND CEMENT ASSOCIATION



A message to railway engineers and executives

The reinforced concrete trestle bridge is a development for which railroad engineers may take full credit. It was first constructed in this country about 28 years ago and has won acceptance as a permanent, dependable and desirable type of bridge.

Recently, notable trestle progress has been made through the use of large piles. The first cost is thus reduced, construction made easier, and economic desirability enhanced. This booklet presents the interesting highlights.

PORTLAND CEMENT ASSOCIATION



They Look the Part. The large-pile trestle has clean-cut lines eloquent of great reserve strength, stability and permanence.



THE LARGE CONCRETE PILE

**MAJOR FORWARD STEP
IN RAILWAY
TRESTLE DESIGN!**



Fewer Bents Needed. New 18-ft. spans replacing old spans of 14 ft. or less.

Greater Load Capacity. Showing field test load of 105 to 110 tons on single 24-in. pile, consisting of weight of crane with heavy load on lowered boom. This trestle is 24 ft. high to base of rail; heights to 30 ft. have been built, the stiff piles requiring no bracing.



Lower Cost in Place. The difference in first cost between temporary and permanent, fireproof construction is greatly reduced by the economy of 3-large-pile bents.

The true measure of pile economy is not cost per pile or foot of pile, but *cost per unit of load capacity*. A 24-in. octagonal concrete pile theoretically has 2.8 times the load capacity of an 11-in. (av. diam.) pile. The capacity ratio in service may be even greater.

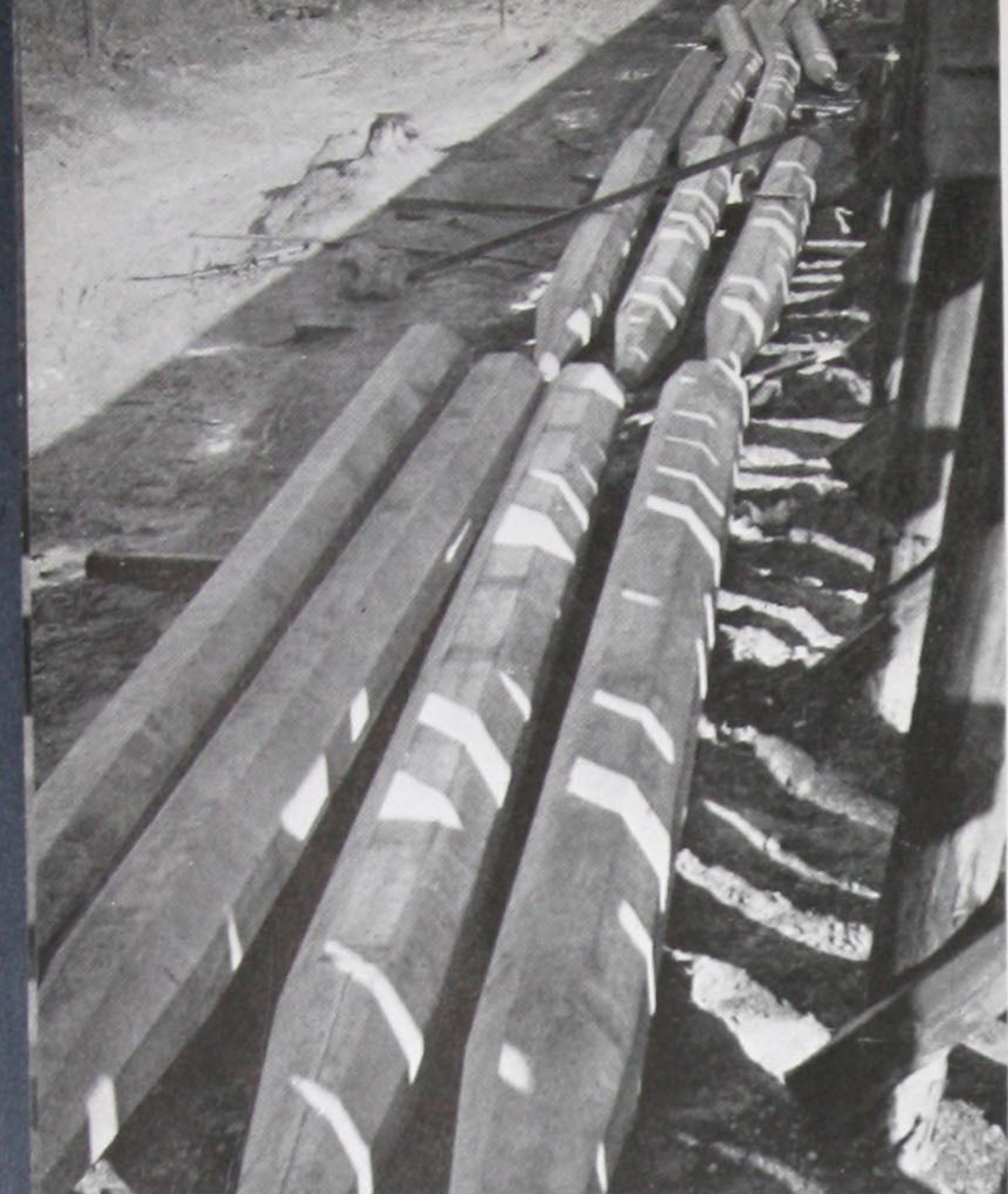
The following costs reported by a mid-western railroad during 1934 are significant.

Average manufacturing cost per foot of 24-in. octagon pile was \$1.28 per lin. ft. (from \$1.04 for 25-ft. to \$1.59 for 60-ft. piles). A 35-ft. pile averaged \$1.185 for manufacture; \$0.65 for driving; \$0.20 for handling and trans-

porting; \$2.035 total cost in place per foot of pile.

To match this cost on a capacity basis at 2.8 ratio, an 11-in. pile would have to be obtained at a cost of only 73 cents in place.

Or, compare on these fair assumptions: An 11-in. (35-ft.) pile at \$0.50 purchasing price costs \$0.95 per ft. in place or \$33.25. At 25 tons capacity, cost per ton is \$1.33. The capacity of a 24-in. pile would be 2.8 times the smaller, or 70 tons, and the cost per ton (2.035 times 35 divided by 70) would be \$1.02—only 77 per cent as much as the small pile.



Beginning New 101-Span Trestle. *Left:* A carload of piles delivered at the site. *Right:* Digging holes to receive the piles, using guide frame to insure exact driving.

Drives as Quickly as Smaller Pile. No leads are used in driving 24-in. concrete piles. A standard hammer of large size is used. Template several feet above ground holds pile vertical.



FASTER, EASIER PILE DRIVING

NO SHIFTING OF STRINGERS

The use of three large piles per bent and precast slabs result in important savings in construction time and cost. The reasons:

1. Only half as many piles per bent.
2. Shifting of stringers no longer necessary. Piles are driven *between* and *outside* the stringer lines.
3. Each large pile takes no longer to drive than a smaller pile.
4. Spans are 18 ft. instead of 14 ft. A 3-pile trestle will have only 38.9 per cent as many piles.

Time lost in repeatedly shifting stringers and clearing for operating traffic is a large item in the cost of 5 and 6 pile trestles. Time studies show that such delays will require practically one-half of each working day on a busy single-track line. With 3-pile construction, delays are so reduced that three to five bents can be driven per 8-hour day.



Stringers Are Not Disturbed! As many as 3 to 9 piles, depending on operating schedule, may be set in place at once and driven in a nearly continuous operation.

. LESS THAN HALF AS MANY PILES!



Perfect Condition of these heads after driving shows that concrete piles can "take it." Ordinary timber cushion block was used.

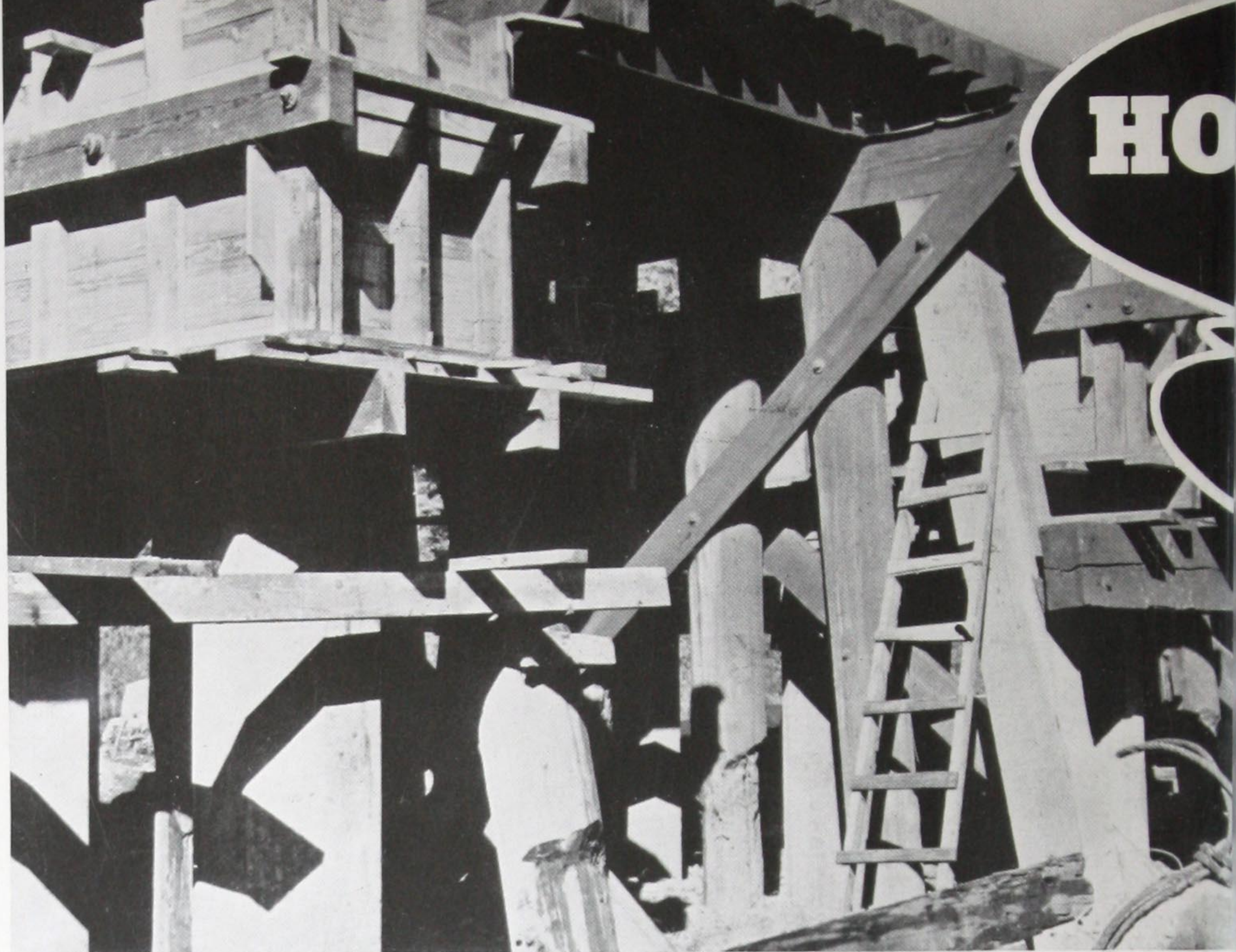
Perfect Splice can easily be made for driven piles which need to be lengthened. Metal forms such as these were used to make the neat splice, seen in nearest pile, in front-cover view.



Cutting Off is Easy. In 12 to 20 minutes concrete is cut away, reinforcement burned through, and head snapped off with eccentric cable hitch as shown.

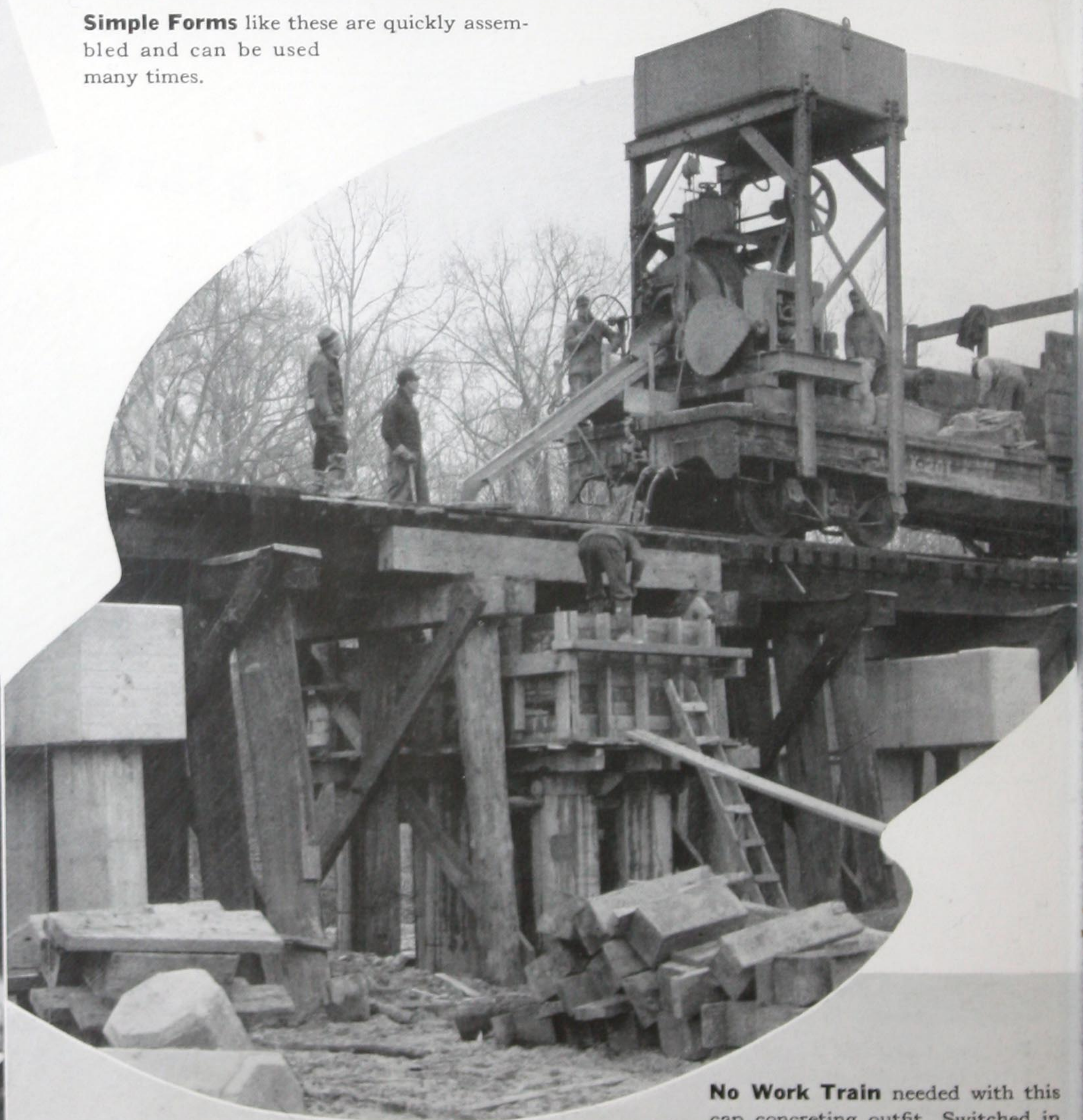
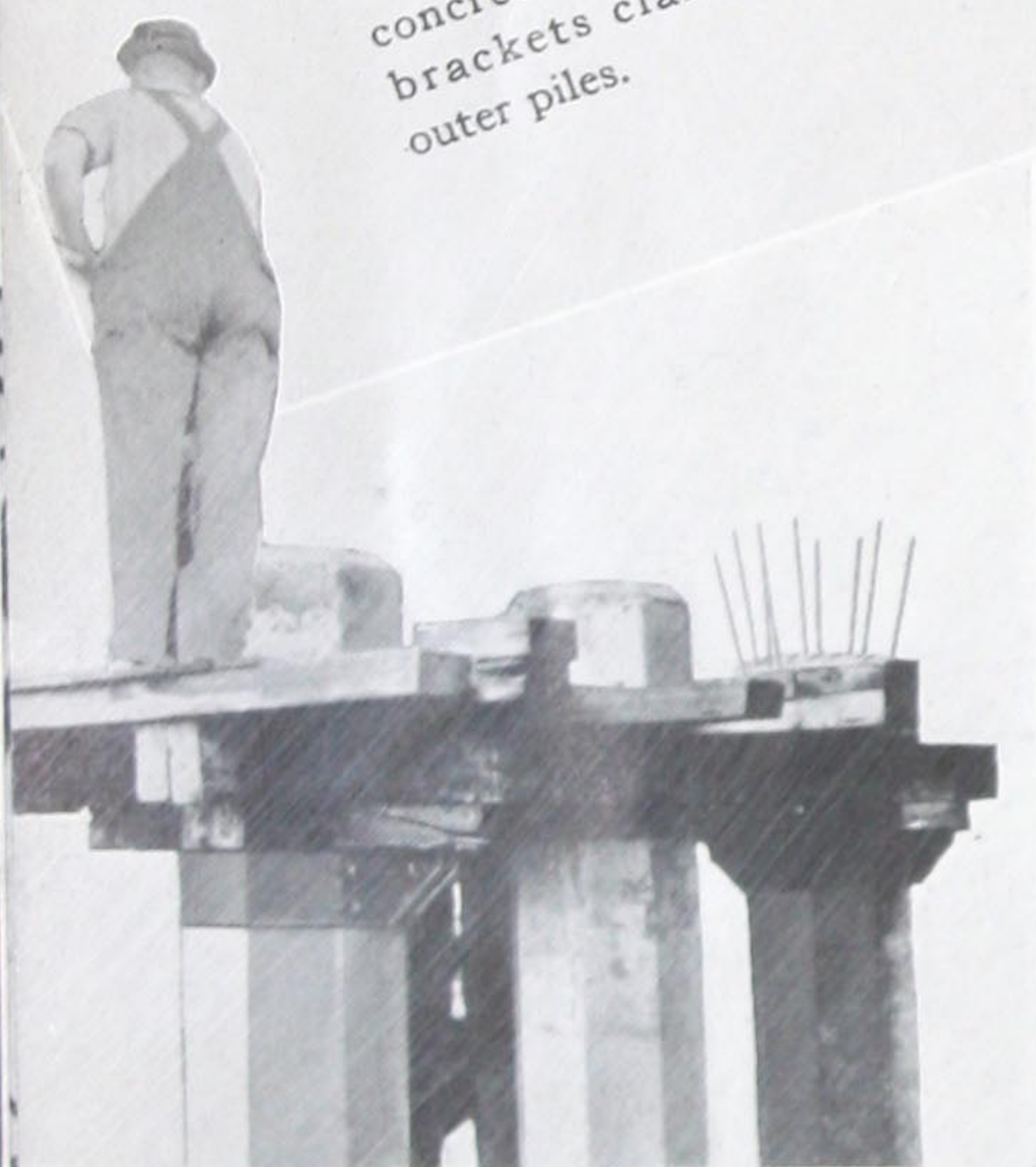


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No Shoring is needed in casting the caps. Forms and fresh concrete are supported by brackets clamped on the outer piles.

Simple Forms like these are quickly assembled and can be used many times.



Typical cap reinforcement in place, ready for concrete.

No Work Train needed with this cap concreting outfit. Switched in and out by the pile driver crane. Mixing water for three caps carried in addition to aggregates and cement.



W CAPS ARE CAST AT LOW COST

For Increased Load Capacity, where required, piles may be surrounded at the ground with a concrete collar, increasing the bearing area and longitudinal stiffness of the bent.

KEEPING UP WITH THE DRIVER

Concrete railway trestles are firesafe. None has ever been lost by fire.

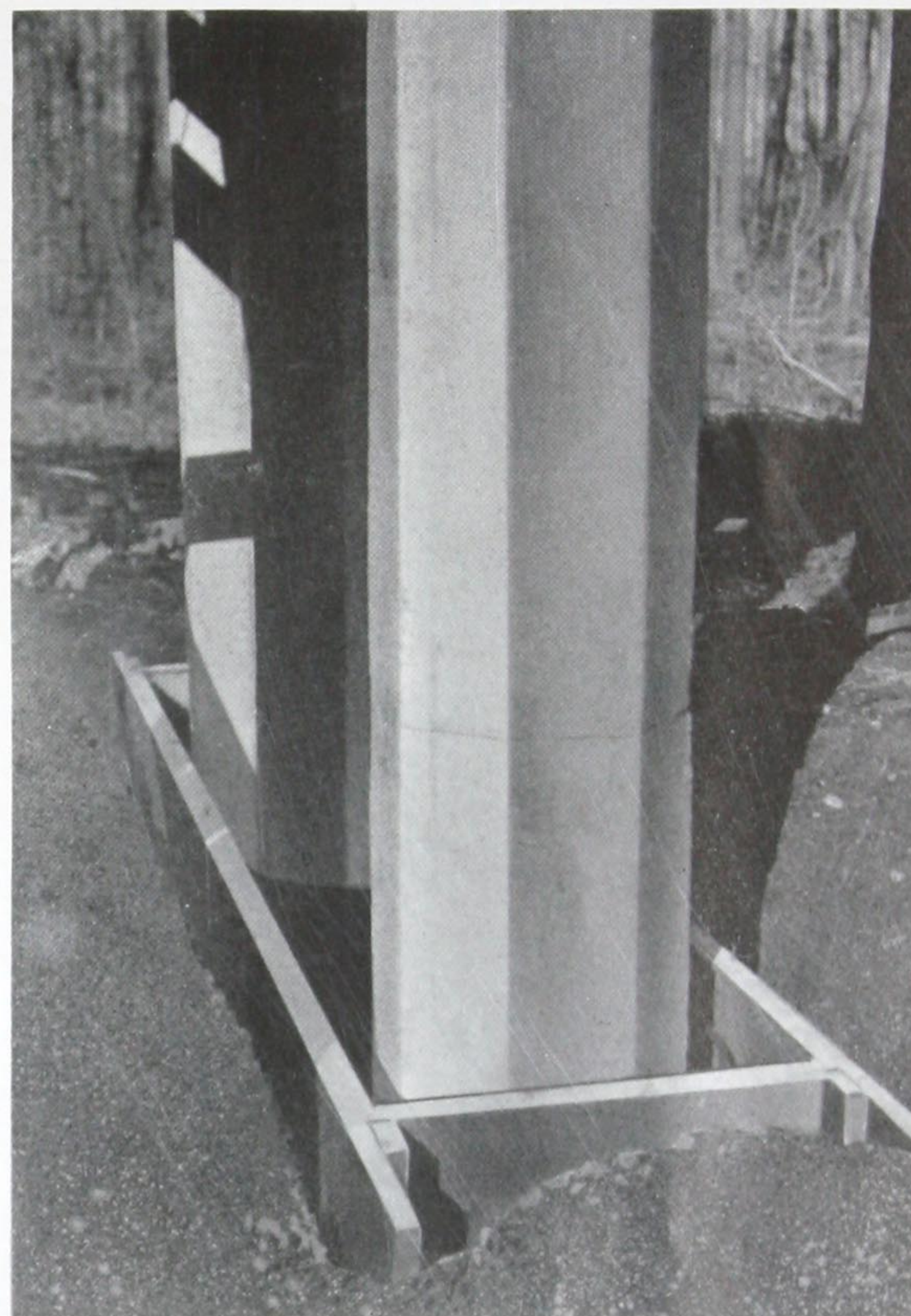
They defy floods. Unless pile support is scoured away, they are safe through over-topping floods. Unobstructed 18-ft. spans facilitate passage of drift.

They have fine appearance—look the part of strong, enduring structures fit to carry modern traffic.

They have reserve strength. Bents of three 24-in. piles have greater bending resistance than ordinary 6-pile bents. Deck slabs, if designed in accordance with A.R.E.A. Specifications, have reserve strength to take care of large future increases in loads—certainly any loads in sight.

They can be erected with least traffic interference, as shown by facts and photos on these pages.

They are low in first cost. Under conditions of considerable traffic interference, first cost may be lowest of any comparable construction.



Ready for the Slabs. 3-pile bents drastically reduce time and cost chargeable to clearing for traffic during construction. Cost less in place than ordinary 6-pile bents.





Removing Old Deck. Light crane clearing for two new deck panels. Ties need not be removed unless they are to be renewed.

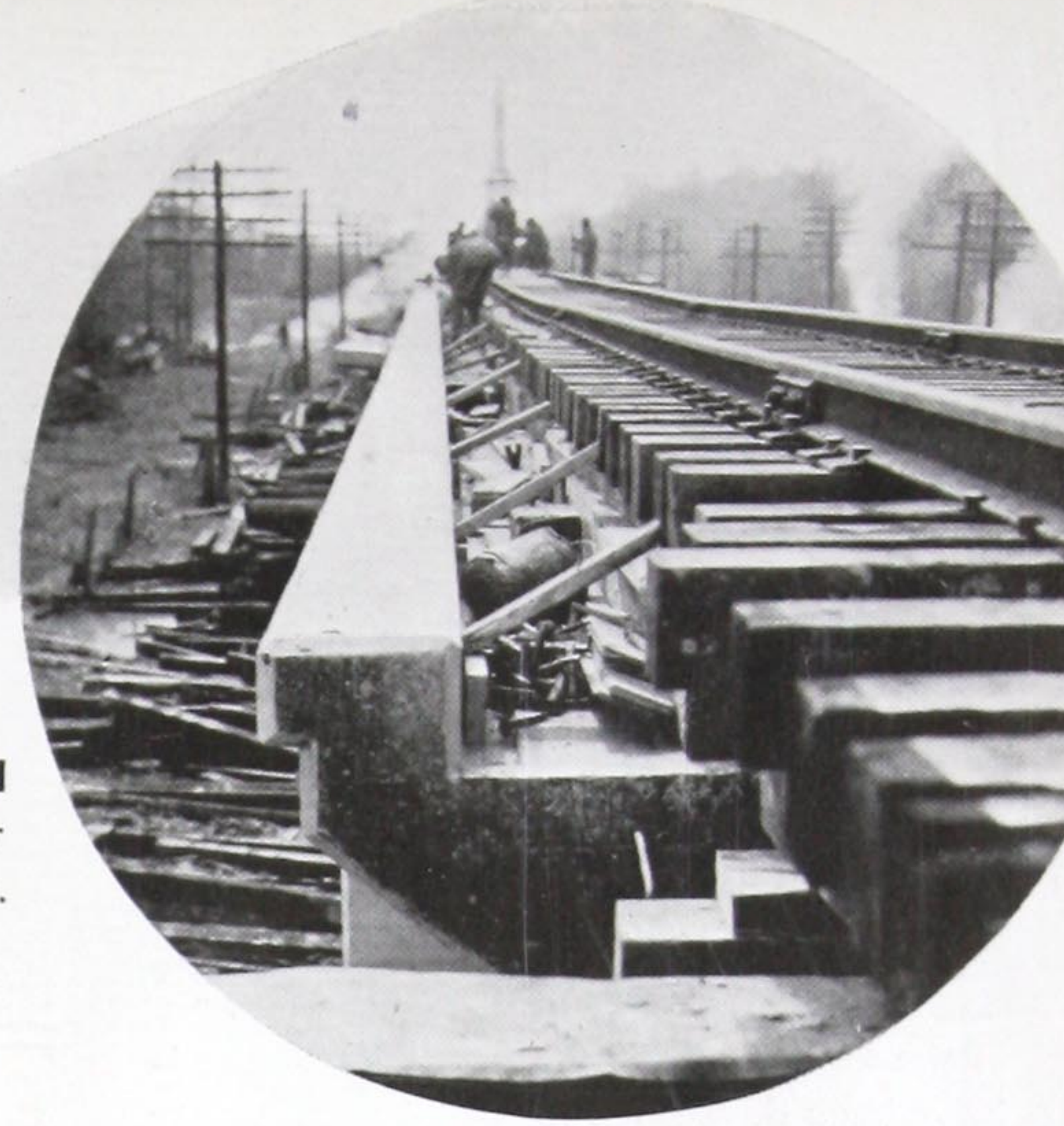


**2 PANELS
IN 45
MINUTES**

Setting 18-Ft. Slabs. Using heavy crane, the crew shown considers it ordinary operation to set two panels (4 half-slabs) and prepare track for traffic in 45 minutes.



A Day's Work ended here. Four to six panels can ordinarily be placed in 8 hours with no delay to operating traffic.



Bring On Your Southbound Limited! Crane clearing after blocking up track on new slab.

Beginning a long life and an economical one.



Now for the Ballast—after which you can practically forget the large-pile concrete trestle.



AND READY FOR TRAFFIC... ANOTHER BLOW AT HIGH COST OF TRAFFIC INTERFERENCE

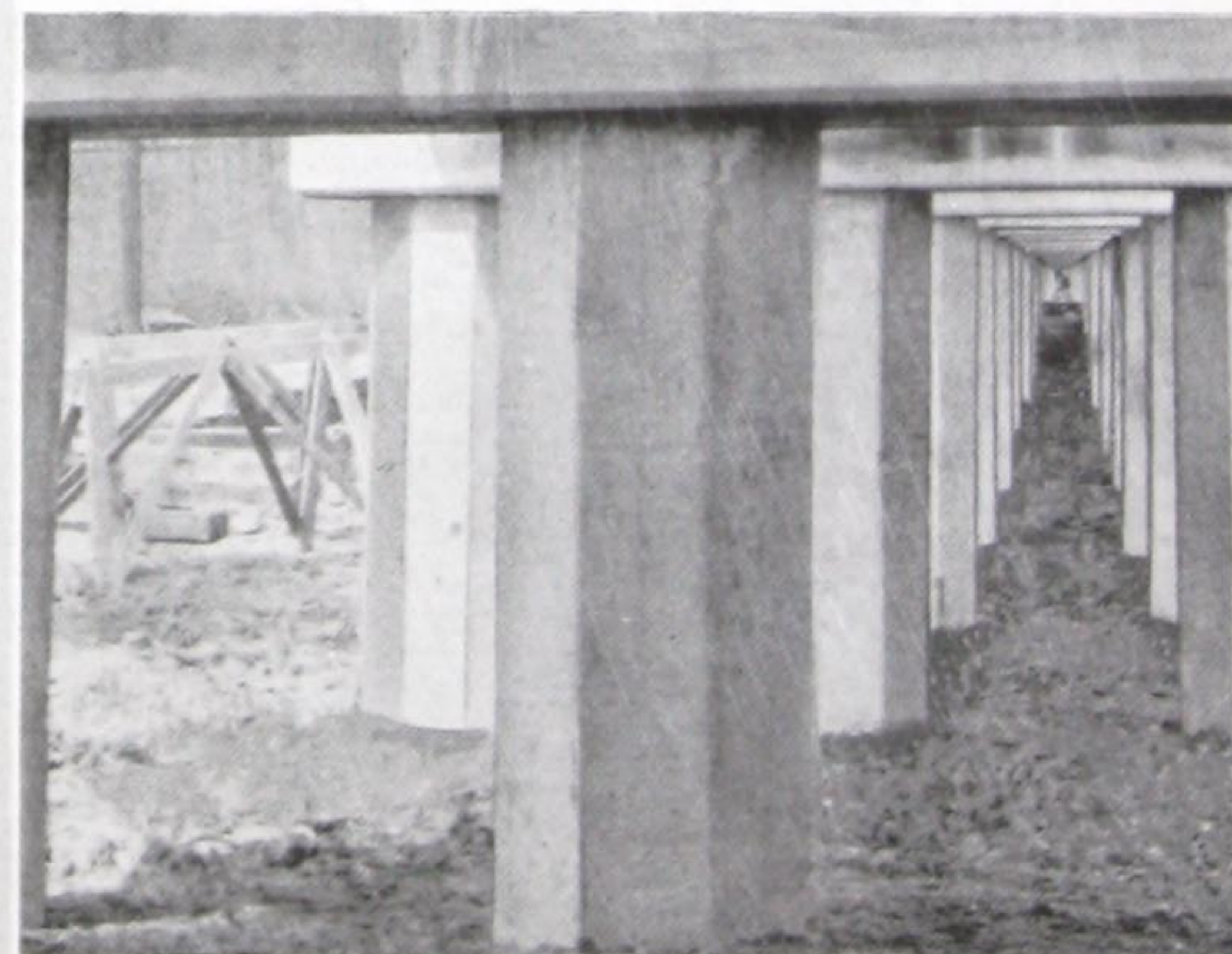
Behind these fast-action scenes are the following interesting cost figures from final accounting records of a leading railroad:

- Complete cost finished trestle, \$49.52 per lin. ft.
- Manufacturing cost of 24-in. piles, \$1.207 per lin. ft.
- Manufacturing cost of deck slabs, \$16.31 per foot of bridge.

The figures cover a 3-pile trestle of fourteen 18-ft. panels; 13 ft. clearance; E-70 loading.

A reliable comparison of total annual costs for various types of construction is afforded by applying the well-known formula, Annual Cost $= Cr + \frac{C'r'}{(1+r')^n - 1} + M + F + E + T^*$. Substitution of typical fair values shows a cost for concrete ballasted deck of \$2.84 per foot of bridge per year. Less permanent types of construction cost 28% to 35% more per year than the 3-pile concrete type, according to economic analysis.

Railway engineers and executives are invited to check these results in detail. The complete figures are given in Concrete Information RB 2-A "The Large Pile Trestle—Economics," sent on request.



*C, first cost; Fraction, sinking fund; M, maintenance; F, fire insurance; E, appearance value (taken as zero); T, appraised continuity-of-service value.



60-Foot Piles in the Making. Methods have been developed for casting uniformly high quality concrete at low costs.

WHERE ECONOMY BEGINS

A MODERN CASTING YARD... EVERY MANUFACTURING ST

The economy and high value of concrete trestles begin in the casting yard, where piles, slabs and sometimes bents are manufactured under rigid control.

For a large trestle replacement program concentrated in one region, it is desirable to have a central, permanent casting yard. Temporary yards, however, can manufacture a relatively small number of units at satisfactory costs. Ready-mixed concrete is often purchased to specifications.

Costs are particularly low when the yard is located to make use of the trackage, water, power, cranes, storage space, second-hand material, repair equipment and tools of an existing store or shop. The regular casting yard crew can use part-time shop and yard employees as extra help when needed.

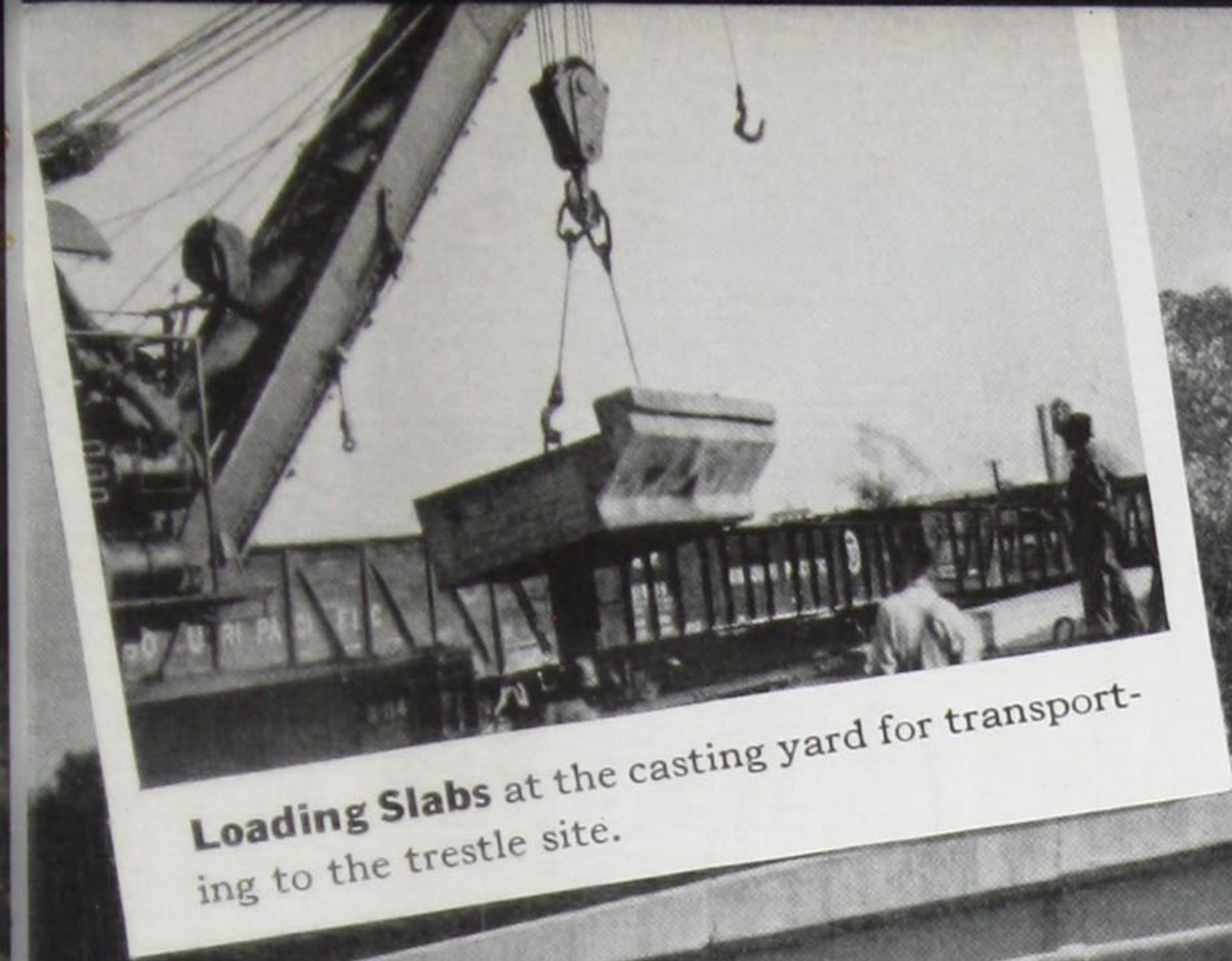
The greatest economy is obtained when a yearly program is adopted and manufacture spread over the entire year or a period when otherwise idle workers and equipment can be used. Once a rate of production is determined, casting platforms, storage facilities for materials, forms, tools and finished units, and necessary equipment can be designed or selected for maximum efficiency.



Typical Forms for octagonal piles.

Proper Curing of piles and slabs is the final step in developing high strength concrete.

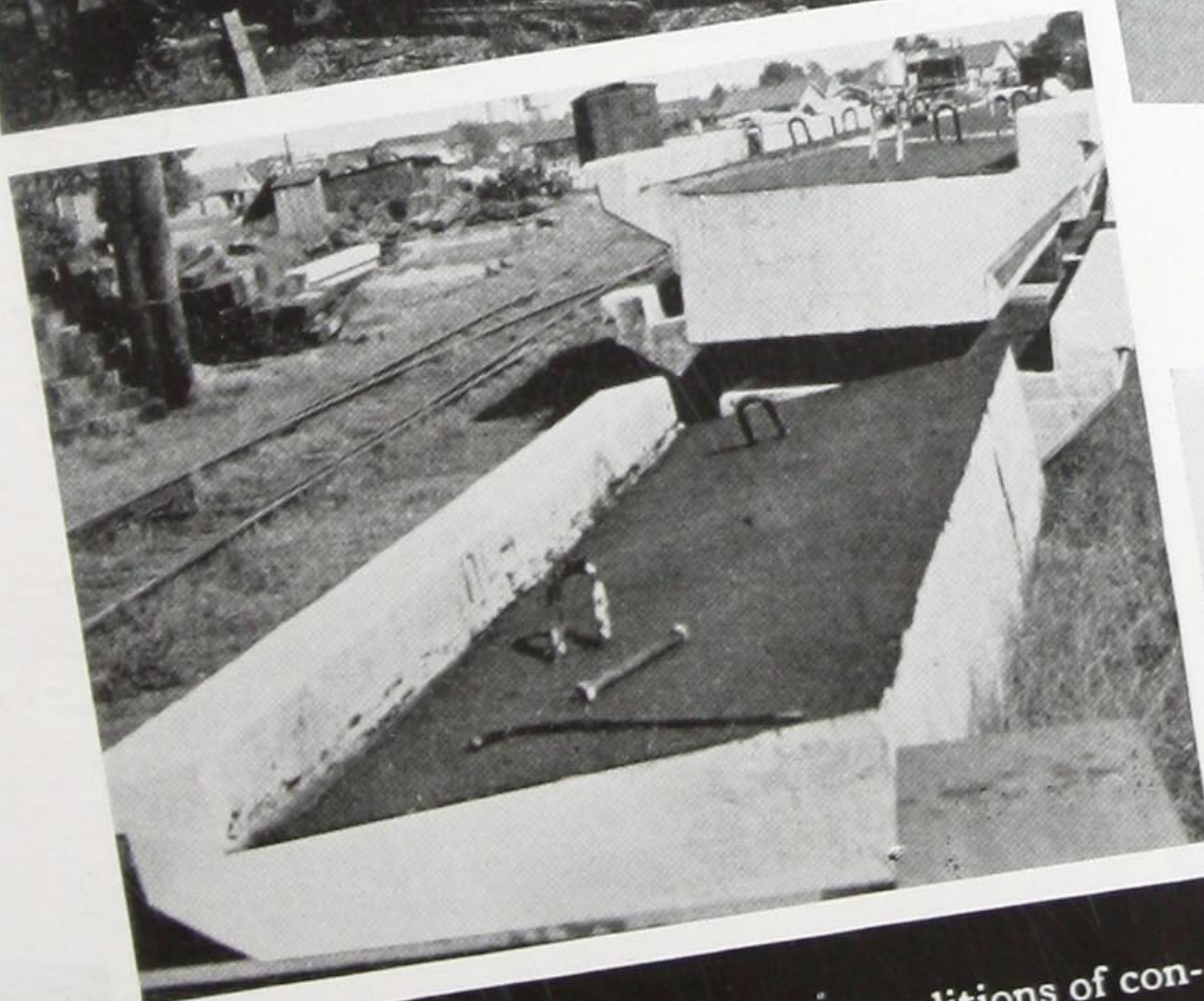




Loading Slabs at the casting yard for transporting to the trestle site.



UNDER RIGID CONTROL



Slabs at casting yard. Favorable conditions of concreting and inspection assure uniform high quality.



Lowest Annual Cost—Permanent, fireproof, floodproof, rotproof, termite proof, high-reserve-strength . . . concrete trestles may even be lowest in first cost thanks to development of large piles.



HAVE YOU THIS CONCRETE INFORMATION?

Large Concrete Piles (Concrete Information RB 1). A technical discussion which includes design sheet, cost data and specifications for constructing, handling and driving large premolded concrete piles.

The Large Pile Concrete Trestle—Economics (Concrete Information RB 2-A). Advantages, cost data and analysis of total annual costs.

The Large Pile Concrete Trestle—Design (Concrete Information RB 2-B). Standard slab and pile designs, with discussion of unit stresses, impact and other questions.

The Large Pile Concrete Trestle—Manufacture and Erection (Concrete Information RB 2-C). Layout and operation of efficient casting yard; equipment and methods for driving piles, concreting caps and setting slabs.

Analysis of Rigid Frame Concrete Bridges (3rd edition). Simple, short-cut methods of designing this

beautiful, economical type of structure, 40 pages, including numerous design charts.

Concrete Bridge Details. Discussion of abutments, bridge seats, joints and other details in light of conditions observed in nation-wide survey. 48 pages.

Vibration—A Better Method of Placing Concrete. Methods, equipment and results of vibratory placement. 36 pages.

Design and Control of Concrete Mixtures. Technical discussion of all phases of quality concrete making. 72 pages.

The Portland Cement Association is a national organization to improve and extend the uses of concrete. Its facilities are at your service. Any of these publications will be sent free on request, without obligation. Information sheets and booklets are also available on other subjects involving the use of concrete.



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